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New Species of the Genus *Caelatura* Conrad, 1865 (Mollusca, Gastropoda, Barleeidae) from off the Brazilian Coast

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Abstract. Six new species of barleeid gastropods of the genus *Caelatura* are described from the Brazilian continental shelf. *Caelatura albertoi* n. sp. occurs off the states of Amapá and Pará (67–173 m depth); *Caelatura aulakiou* n. sp. is found off Amapá (160 m depth); *Caelatura uoxia* n. sp. is found off Espírito Santo (20–96 m depth); *Caelatura carinata* n. sp. is found off Ceará (70 m depth); *Caelatura plrix* n. sp. is found off the state of Bahia (50–67 m depth) and *Caelatura tupi* n. sp. is found off Sergipe (25–900 m depth). These species are compared to six other *Caelatura* species previously reported from the same region. This is the first report of the genus *Caelatura* from northern Brazil.

INTRODUCTION

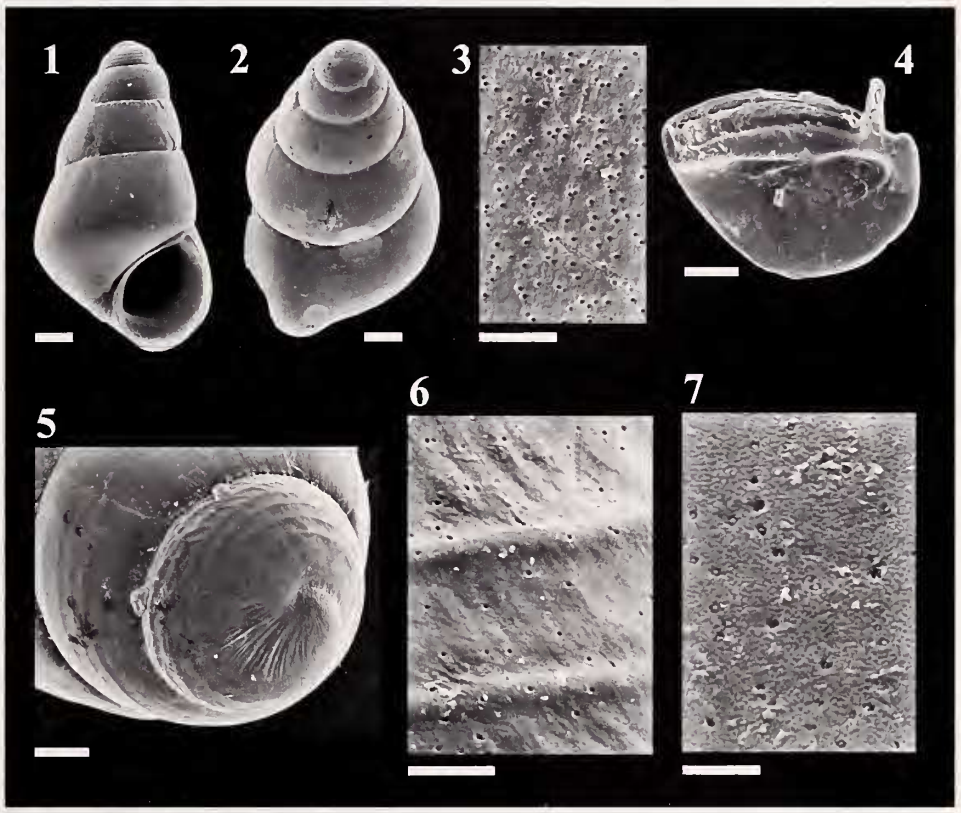
Barleeid molluscs of the genus *Caelatura* Conrad, 1865 are minute gastropods, about three millimeters long, that usually inhabit shallow waters of the continental shelf. They are present in most of the Western Atlantic (Ponder, 1983; Rios, 1994).

In the Western Atlantic Ocean eight species of *Caelatura* have been reported. Six of them inhabit the Brazilian coast: *C. pernambucensis* (Watson, 1886) and *C. rustica* (Watson, 1886), *C. barcellosi* Absalão & Rios, 1995 and *C. spirocordata*, Absalão & Rios, 1995 and *C. speculabunda* Absalão, 2002 and *C. tigrina* Absalão, 2002. The first two species and *C. microstoma* (Watson, 1886) were described in *Rissoa* and, subsequently reassigned to *Caelatura* by Ponder (1983). *Assiminea gerhardtae* De Jong & Coomans, 1988 was described from the Caribbean region, but Rolán & Crúz-Ábrego (1998) re-classified it to *Caelatura* based on the smooth protoconch without minute pits, the penis shape and the similar shell profile to *C. rustica* (see Rolán & Crúz-Ábrego, 1998: 5). This species is discussed with respect to *C. albertoi* n. sp. and *C. aulakiou* n. sp. because all of them are devoid of conspicuous sculpture. All other species presently classified in *Caelatura* were originally described in that genus.

MATERIALS AND METHODS

The material analyzed was provided by the oceanographic expeditions GEOMAR I Amapá and Pará states (June 1965); GEOMAR II, (September 1970); by AMASSEDS, Amapá State (October 1991); by REVIZEE Program, Score Nordeste (November 2000), and Score Central (February and April 1996; June and July 2001); PCABS – Petrobras (April 2002). The shells were observed with optical and scanning electron microscopes. Identifications were done from published descriptions (Watson, 1886; Ponder, 1983; Rios, 1994; Absalão & Rios, 1995; Absalão, 2002; Rolán & Crúz-Ábrego, 1998) and from comparison with type-material and/or original descriptions and illustrations. The descriptions were based on shell characters and discussion will be restricted to those species belonging to their specific ornamented group, e.g., smooth members of *Caelatura* will be compared only with other smooth *Caelatura*. The number of protoconch whorls was counted by the method of Leal (1991).

Abbreviations used: AMASSEDS—Multidisciplary Amazon Shelf Sediment Study; DOUFPE—Departamento de Oceanografia, Universidade Federal de Pernambuco, Recife, Brazil; GEOMAR—Programa de Geologia Marinha do Brazil; IBUFRJ—Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil; MNRJ—Museu Nacional do Rio de Janeiro, Rio de Janeiro, Brazil; MORG—Museu Oceanográfico "Eliézer de Carvalho Rios" da Fundação Oceanográfica do Rio Grande, Rio Grande, Brazil; PCABS—Projeto de Caracterização Ambiental da Bacia de Sergipe (Sergipe Basin Environmental Characterization Project, Petrobras Co.); REVIZEE—Programa de Avaliação do Potencial Econômico da Zona Econômica Exclusiva do Brasil; MZSP—Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil; ZMA—Zoölogisch Museum Amsterdam, Amsterdam, The Netherlands. MNHN—Muséum national d'histoire naturelle, Paris, France.



Figures 1–7. *Caelatura albertoi* n. sp. Figure 1. holotype (MNRJ 10305), length 1.75 mm; Figure 2. paratype (IBUFRJ 14182), length 1.7 mm; Figure 3. detail of sculpture of teleoconch of holotype; Figure 4. operculum of a spare specimen IBUFRJ 14186; Figure 5. protoconch of paratype; Figure 6, 7. detail of protoconch of holotype, scale 5 µm. Scale bar: 1: 200 µm; 2: 100 µm; 3, 6: 10 µm; 4, 5: 50 µm; 7: 5 µm.

Systematics

Barleeidae Gray, 1857

Caelatura Conrad, 1865 Type species: *Pasithea sulcata* Lea, 1833: 124, fossil, Eocene, Alabama, USA. Subsequent designation by Ponder (1983: 244).

Diagnosis: (based on Ponder 1967; 1983).

Shell stout, elongate-conical, usually non-umbilicate, smooth or with axial or spiral sculpture, microsculptured with irregular minute pits; protoconch paucispiral, dome-shaped, sculptured with very closely packed, minute irregular pits; operculum oval, corneous, with or without peg, eccentric nucleus.

Caelatura albertoi n. sp. (Figures 1–7)

Description: Shell conical, whorls slightly convex, light cream, opaque. Protoconch paucispiral, about 2 whorls, macroscopically smooth (Figure 5, 6–7) obsolete spiral threads. Opisthocline axial threads may be present. Pits spreading irregularly over entire protoconch. Teleoconch smooth but abundant microscopic deep pits. Suture impressed. Base slightly convex. Aperture suboval posteriorly angled, varicose. Minute umbilical chink. Operculum ovoid, red-orange, a sulcus along inner (columellar) edge, strong longitudinal rib near columellar edge. Peg rises from most posterior part of longitudinal rib extending beyond inner edge.

Dimensions: Holotype with 3.5 whorls in teleoconch; height 1.75 mm; width 1.0 mm.

Type locality: AMASSEDS, sta. 4134, 02°21′00″N, 48°29′00″W, 72 m, Cruise IV, *leg.* 1, 22/x/1991, RV "Columbus Iselim," Amapá State, off northern Brazil.

Type material: Holotype: MNRJ 10305; paratypes (five shells in each lot): IBUFRJ 14182; MNRJ 10306; MZSP 43204; MORG 41071; ZMA 4.04.046; MNHN; DOUFPE 5023. All paratypes from type locality.

Additional material: GEOMAR I, sta. 72 Am.105S, 02°51′42″N, 48°46′00″W, 86 m, 14/vi/1965, [17]; sta. 73 Am.106 03°04′18″N, 48°25′00″W, 173 m, 14/vi/1965, [1], Amapá and Pará State; GEOMAR II, sta. 72 03°04′00″N, 48°52′48″W, 13/ix/1970, 94 m, [1]; sta. 92 Am. 32 02°52′12″N, 49°19′00″W, 09/xi/1970, 65 m, [6]; sta. 124 03°32′12″N, 48°59′48″W, 13/ix/1970, 103 m,

[19]; sta. 2413 Am.134S 04°18′48″N, 05°17′06″W, 89 m., 27/ix/1970, [15]; sta. 2425 Am. 152A 03°33′12″N, 49°32′18″W, 87.4 m, 30/ix/1970, [3]; sta. 2441 Am.174S 01°46′00″N, 47°14′00″W, 10/x/1970; 77 m, [1]; all Amapá State; AMASSEDS, sta. 4134, 02°21′00″N, 48°29′00″W, 72 m, 22/x/1991 [137]; sta. 4128 03°25′00″N, 49°54′00″W, 71 m, 21/x/1991, [1]; REVIZEE Central, sta. 20 19°16′05″S, 38°00′32″W, 67 m, 28/vi/2001 [17].

Etymology: This species is named for Dr. Alberto Garcia de Figueiredo Júnior, who kindly allowed us access to malacological material from the Oceanographic Operation GEOMAR I.

Distribution: Amapá to Pará, Northern Brazil (02°21′00″ N to 19°16′05″ S).

Remarks: As a smooth species, *C. albertoi* resembles *C. rustica* (see Ponder, 1983: 268, fig. 16a), *C. gerhardtae* De Jong & Coomans, 1988 (see Rolán & Crúz-Ábrego, 1998: 6, fig. 15) and *C. aulakion* n. sp. *Caelatura albertoi* has a stronger varix than that of *C. aulakion*, and a granulose texture on the protoconch, whereas it is smooth in the latter species. Also, *C. aulakion* has a peripheral furrow between the body whorl and the base, whereas *C. albertoi* has no such furrow. *Caelatura albertoi* can be distinguished from *C. rustica* and *C. gerhardtae* by the lack of a varix behind the aperture in the two latter species.

Caelatura aulakion n. sp. (Figures 8–13)

Description: Shell conical, whorls slightly convex, cream-whitish with pale orange spots, opaque. Protoconch paucispiral, macroscopically smooth, 6–7 thin spiral threads. Pits spreading irregularly over entire protoconch. Teleoconch smooth, but microscopic, irregularly arranged deep pits. Shallow furrow present between body whorl and base. Suture impressed. Base slightly convex. Aperture suboval. Lip thin. Umbilicus lacking. Aperture varicose.

Dimensions: Holotype with 3.5 whorls in teleoconch; height 2.2 mm; width 1.25 mm.

Type locality: Amapá, 04°27′00″N, 49°58′00″W, 160 m, 13/x/2000, Amapá State, northern Brazil.

Type material: Holotype: MNRJ 10308; paratypes (three shells in each lot): IBUFRJ 14181; MNHN; MORG 41072; ZMA 4.04.045; MZSP 43205; DOUFPE 5025 All paratypes from type locality.

Etymology: *aulakion* = n. dim. from *aulax* (L.) and *-akos* (Gr.) referring to the furrow bordering the last whorl.

Distribution: Amapá State, northern Brazil.

Remarks: *Caelatura aulakion* is distinguished from *C. albertoi* as discussed for *C. albertoi*. *Caelatura aulakion* can be distinguished from *C. rustica* and *C. gerhardtae* by having a varix behind the aperture, whereas the latter two species do not. Furthermore, *C. aulakion* has irregular pits on the protoconch, whereas they are absent in both *C. rustica* and *C. gerhardtae*.

Caelatura carinata n. sp. (Figures 14–19)

Description: Shell pupoid-elongate, stout, whorls angulated in median portion, yellow-orange, opaque. Protoconch hemispherical, paucispiral, macroscopically smooth. Teleoconch carinate at mid-whorl, 5 strong undulating rounded spiral cords on penultimate whorl, 7 on body whorl, 4–5 more at base. Interspaces between spiral cords deeply grooved, separated by ridges like fine granulated blades. Deep pits at top of spiral cords in somewhat linear arrangement. Width of interspaces variable, usually about same width as spiral cords. Suture impressed. Aperture suboval. Lip thin. Minute chink-like umbilicus.

Dimensions: Holotype with 3.75 whorls in teleoconch; height 1.45 mm; width 0.7 mm.

Type locality: REVIZEE NE IV sta. 130A, 4° pernada 03°20′00″S, 38°11′00″W, 71 m, 14/xi/2000, RV "Antares," northeast Brazil.

Type material: Holotype: MNRJ 10307; paratypes: DOUFPE 4938 [1]; IBUFRJ 14179 [1]; DOUFPE 4907 [1].

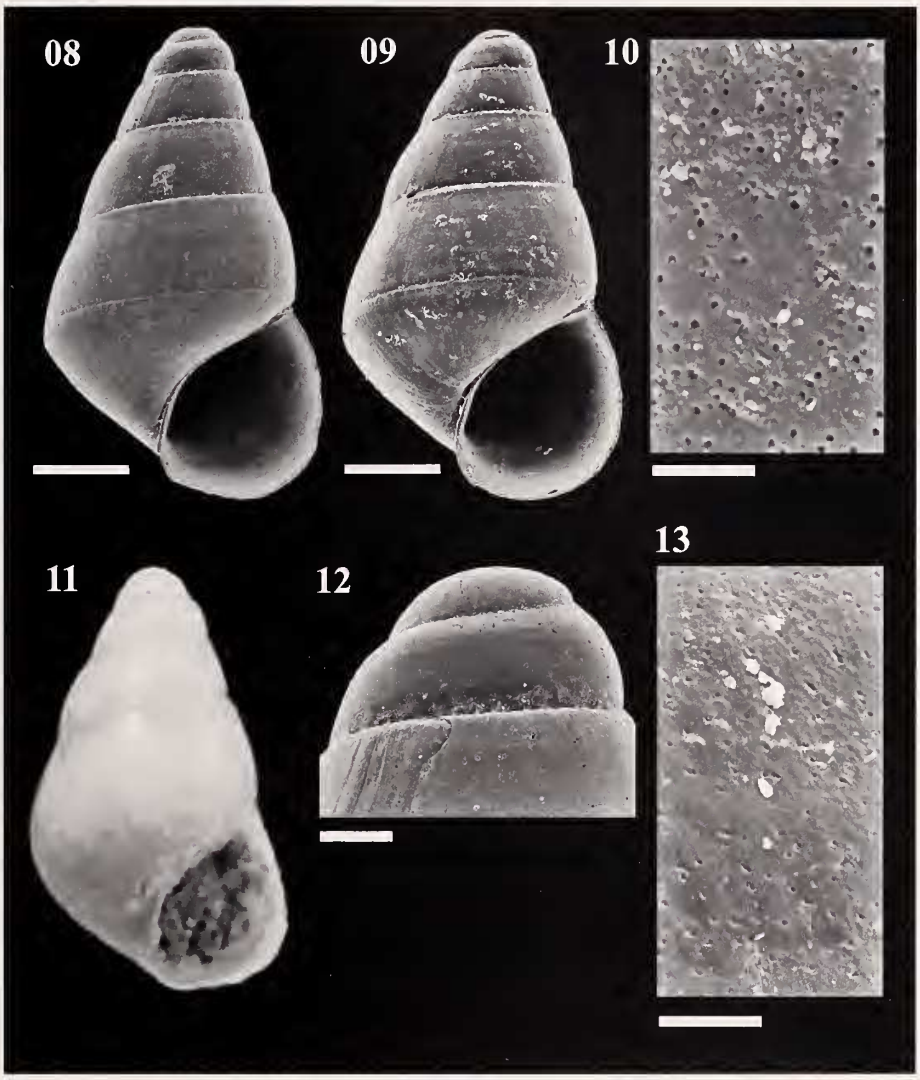
Etymology: *carinata* from Latin, *carina* referring to the spiral keels that ornament this species.

Range: Northeast Brazil.

Remarks: *Caelatura carinata* shares its prominent spiral sculpturing with all other species in this group (*C. spirocordata*; *C. tigrina* and *C. speculabunda*; *C. phrix* n. sp. and *C. tupi* n. sp.). *Caelatura carinata* n. sp. is unique in that the protoconch is more hemispherical and smooth, whereas in the other species the beginning of the protoconchs are dome-shaped and show no clear boundary between the protoconch and teleoconch, with spiral ornamentation being continuous in both teleoconch and protoconch. Furthermore, in *C. carinata* n. sp. the whorls are strongly medially-angled, whereas all the others have convex whorl profiles.

Caelatura noxia n. sp. (Figures 20–22, 24–27)

Description: Shell minute, elongate-pupoid, whorls convex, slightly staggered, cream to orange-reddish, lustrous, opaque. Protoconch paucispiral, 4–5 strong spiral rounded cords. Teleoconch with 4–5 strong undulating rounded spiral cords intercalating spiral



Figures 8–13. *Caelatura aulakion*. n. sp. 08. holotype (MNRJ 10308), length 2.2 mm; 09. paratype (IBUFRJ 14181), length 1.25 mm; 10. sculpture of the teleoconch of paratype; 11. *Caelatura rustica* syntype (BMNH 1887.2.9.1969–74), length 2.1 mm; 12. protoconch of holotype; 13. detail of the protoconch of paratype. Scale bar: 08–09: 400 μm; 10–13: 10 μm; 12: 100 μm.

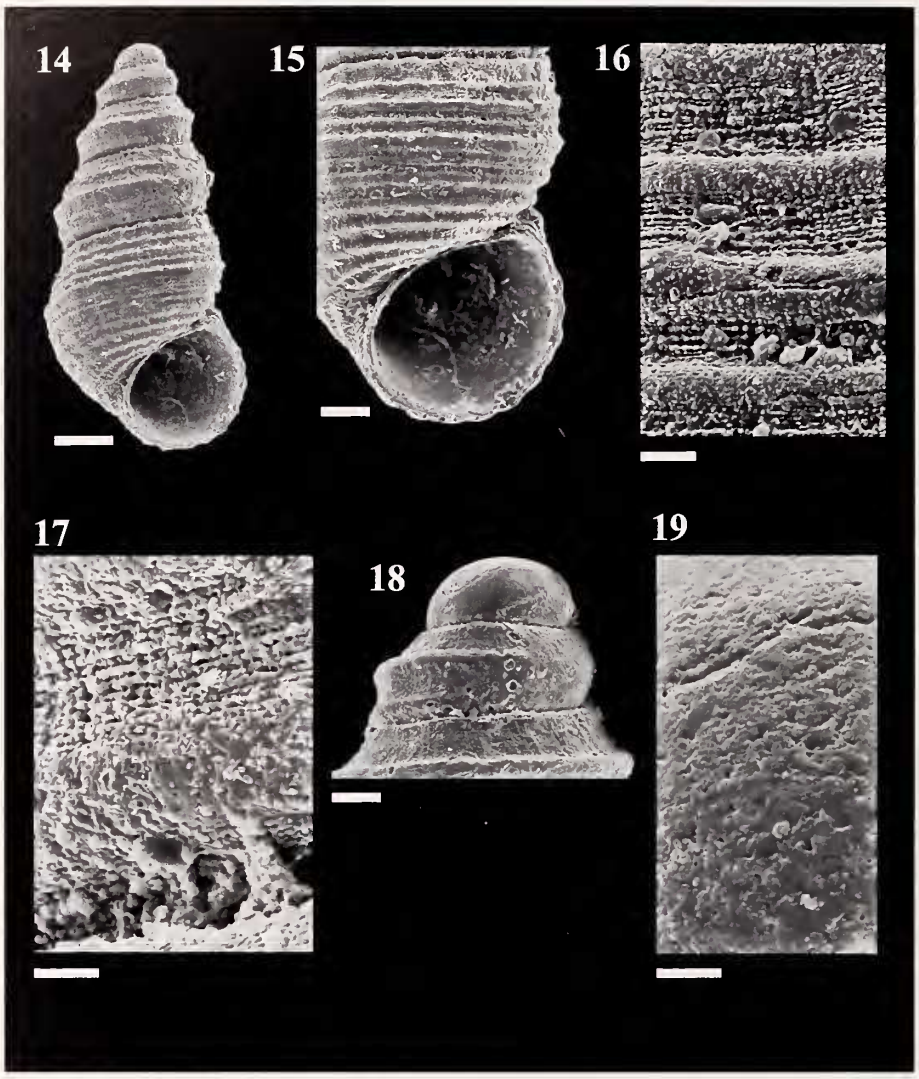
cordlets, cordlets about 1/3 of width of cords. Deep incised groove between cords, cordlets with same cord width, with additional very fine spiral sculpturing of about 10 laminate ridges. Numerous deep pits aligned over top of spiral cords. Suture impressed. Base convex with about 7 spiral cords. Aperture suboval, varicose. Minute chink-like umbilicus. Operculum oval, red, sulcus along inner (columellar) edge, strong longitudinal rib in middle of operculum. A peg rises from the most posterior part of the longitudinal rib extending beyond inner edge, but a laminar expansion linking it to the main body of operculum.

Dimensions: Holotype with 3.5 whorls in teleoconch; height 2.6 mm; width 1.2 mm.

Type locality: REVIZEE Program Score Central, sta. vv38, 22°00′24″S, 40°05′15″W, 100 m, 21/vii/2001.

Type material: Holotype: MNRJ 10311; paratypes (one in each lot): IBUFRJ 9520; DOUFPE 5026; MORG 41070; MZUSP 43202; MNHN; ZMA 4.04.044; IBUFRJ 14183. All from type locality.

Additional material: IBUFRJ 11941, sta. 20 raso, 19°16′05″S, 38°00′32″W, 67 m, 28/vi/2001, [1]; IBUFRJ 9800, sta. vv38 19°28′00″S, 38°22′00″W, 29/ii/1996 [115]; sta. 24 20°21′00″S, 36°38′00″W, 55 m, 13/vi/2001; IBUFRJ 8139, sta. D39, 19°28′00″S, 38°22′00″ W, 74 m, 29/ii/1996, [1]; sta. C61, 20°30′38″S, 37°19′06″W, 24/iv/1996, [1]; IBUFRJ 10221, sta. C62, 20°30′02″S, 37°28′51″W, 96 m, 25/iv/1996, [17]; IBUFRJ 9520, sta.



Figures 14–19. *Caelatura carinata* n. sp. 14. holotype (MNRJ 10307) length 1.45 mm; 15. aperture; 16, 17. microsculpture of the teleoconch; 18. protoconch; 19. detail of the protoconch of holotype. Scale bar: 14: 250 μm; 15, 20: 100 μm; 16: 20 μm; 17, 19: 10 μm.

C62, 20°30′02″S, 37°28′51″W, 96 m, 25/iv/1996, [34]; IBUFRJ 14184, sta. C62, 20°30′02″S, 37°28′51″W, 96 m. 25/iv/1996, [1], all REVIZEE Score Central; IBUFRJ 7461, Espírito Santo State, 20 m, 1994, [12]. IBUFRJ 13794, Piúma, Espírito Santo, 1993; sta. D39, 19°28′00″S, 38°22′00″W, 29/ii/1996 [1].

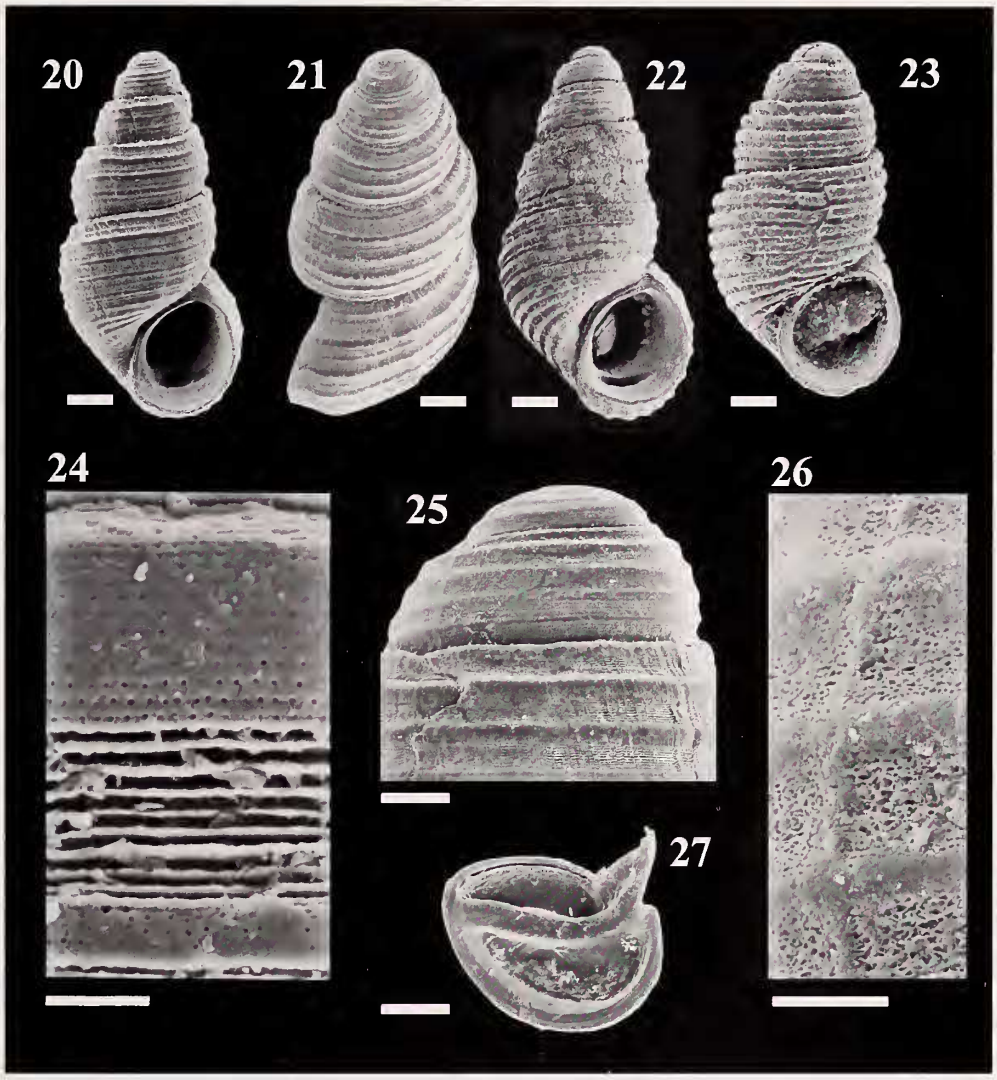
Etymology: *noxia* from Latin, referring to fault, error; see Remarks.

Range: Espírito Santo State, Southeast Brazil (19°16′05″S to 20°30′38″S).

Remarks: *Caelatura noxia* was erroneously illustrated as *C. spirocordata* by Absalão (2002: 3, fig. 9). However, *C. noxia* has more whorls in the teleoconch (4.5 in *C. noxia* 3.5 in *C. spirocordata*) and spiral cords thinner than those of *C. spirocordata* (Figure 23), and also it has secondary spiral cordlets. The presence of secondary spiral cordlets and the length of shell effectively distinguish *C. noxia* from all other species.

Caelatura phrix n. sp. (Figures 28–31, 33, 34)

Description: Shell conical-elongated, stout, opaque, first whorls slightly convex, body whorl broad. Protoconch paucispiral with 4 spiral cordlets. Teleoconch with 6 undulating rounded spiral cords, first two thinner and closer than others; third cord most prominent. Interspaces incised, broader than spiral cords and with about 18 somewhat irregular, corrugated bladed ridges. About 17 rows of deep pits on top



Figures 20–27. *Caelatura noxia* n. sp. 20. holotype (MNRJ 10311), frontal view, length 2.6 mm; 21. holotype showing varix (see arrow) behind aperture; 22. paratype (IBUFRJ 9520), length 2.02 mm; 23. *Caelatura spirocordata* (IBUFRJ 8505) length 1.7 mm; 24. detail of pits over top of the spiral cords at teleoconch; 25. protoconch of holotype; 26. detail of sculpture of the protoconch; 27. operculum of a spare specimen (IBUFRJ 14184). Scale bar: 20–23: 200 μm; 24, 26: 20 μm; 25: 50 μm; 27: 100 μm.

of spiral cords. Suture impressed. Base convex. Aperture rounded-oval. Outer lip varicose.

Dimensions: Holotype with 4.5 whorls in teleoconch; height: 2.7 mm; width 1.35 mm.

Type locality: REVIZEE Central V sta. 13B, 16°47′14″S, 38°41′14″W, 50 m, 30/vi/2001, RV "Astro Garoupa," Bahia State, northeast Brazil.

Type material: Holotype: MNRJ 10309; paratypes (one in each lot): IBUFRJ 11927; MORG 41073; MNHN; all paratypes from type-locality.

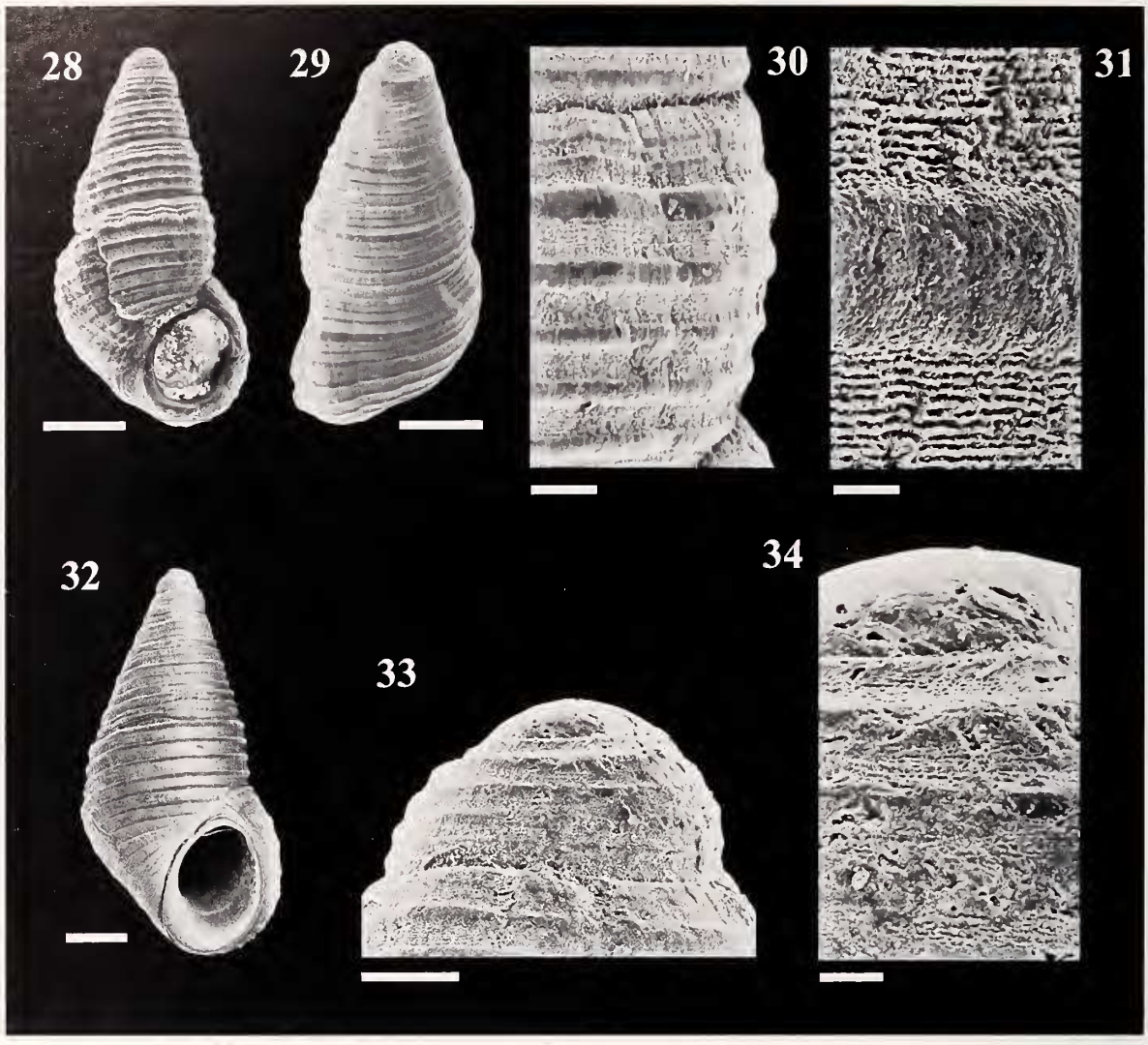
Etymology: *phrix* from Greek, referring to ripple, denoting the undulating axial ribs.

Range: Northeast of Brazil.

Remarks: *Caelatura phrix* n. sp. can be distinguished from all other spirally ornamented species of *Caelatura* by the presence of double minor spiral cords just below the suture. *Caelatura phrix* typically has conspicuous axial rounded ribs, but sometimes *C. tigrina* may have similar ornamentation. However, *C. tigrina* (Figure 32) has a more triangular spire profile and less convex whorls than *C. phrix* n. sp.

Caelatura tupi n. sp. (Figures 35–39)

Description: Shell conical, stout, whorls slightly convex, cream, opaque. Protoconch paucispiral, macroscopi-



Figures 28–34. *Caelatura phrix* n. sp. 28. holotype (MNRJ 10309), length 2.7 mm; 29. holotype showing varix; 30. sculpture of the teleoconch; 31. detail of microsculpture of the teleoconch; 32. *Caelatura tigrina* paratype IBUFRJ 12037; 33. protoconch of holotype; 34. detail of protoconch of holotype. Scale bar: 28, 29: 500 μm; 30, 33: 100 μm; 31, 34: 20 μm; 32: 200 μm.

cally smooth, with 3–4 spiral cords. Teleoconch with 5–6 undulating rounded spiral cords, sometimes intercalated with one spiral cordlet. Incised interspaces broader than spiral cords, showing about 9 corrugated spiral ridges. Top of spiral cords with about 12 rows of deep pits. Suture impressed. Base convex. Aperture oval. Outer lip thick. Inner lip thin. Minute umbilical fissure.

Dimensions: Holotype with 3.5 whorls in teleoconch; height 1.9 mm; width 1.0 mm.

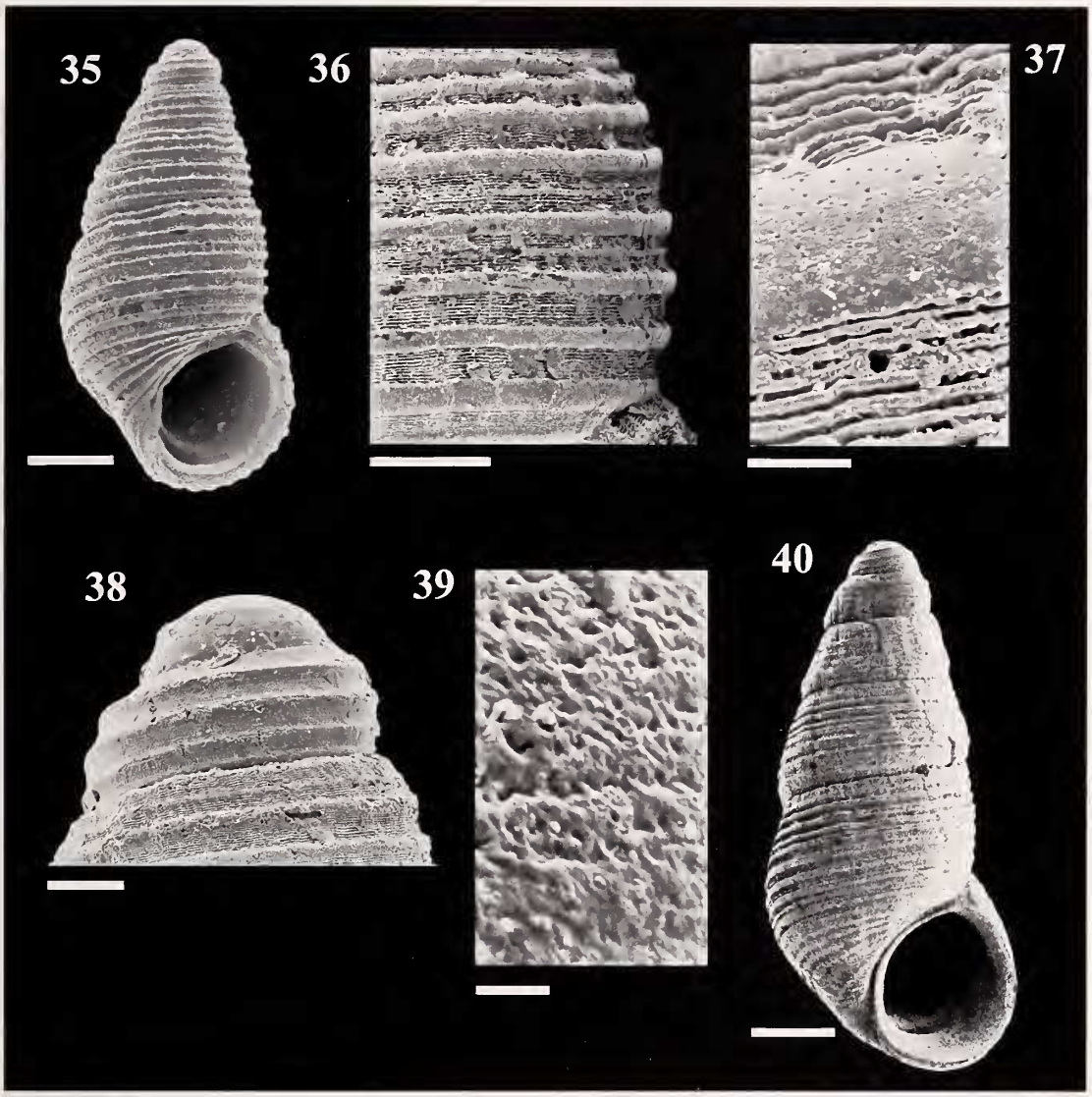
Type locality: REVIZEE V sta. 13B, 16°47′14″S, 38°41′14″W, 30/vi/2001, 40 m, RV "Astro Garoupa," Bahia State, Northeast of Brazil.

Type material: Holotype: MNRJ 10310; paratypes (one for each lot): IBUFRJ 14180; MZSP 43444; MORG 41074; ZMA 4.04.047; DOUFPE 5024. All paratypes from type-locality.

Etymology: *tupi* is the name of the one of the largest Indian tribes which inhabited Brazil in the sixteenth century: noun in apposition.

Range: Northeast Brazil.

Additional material: Revizee V sta. 20 19°16′05″S, 38°00′32″W, 67 m, 28/vi/2001; Revizee Central I sta. vv21 20°28′00″S, 40°00′00″W, 25.37 m, 26/ii/1996; Revizee V sta. 44 20°51′00″S, 33°38′00″W, 65 m, 11/



Figures 35–40. *Caelatura tupi* n. sp. 35. holotype (MNRJ 10310), length 1.9 mm; 36. sculpture of the teleoconch; 37. detail of microsculpture of the teleoconch; 38. protoconch of holotype; 39. detail of sculpture of the protoconch; 40. *Caelatura speculabunda* holotype (MNRJ 8621), length 2.46 mm. Scale bar: 35, 40: 400 µm; 36: 10 µm; 37: 200 µm; 38: 100 µm; 39: 5 µm.

vii/2001; Bacia de Sergipe/Petrobras sta. 9.2 Am.2 11°30′08″S, 37°07′56″W, 900 m, 19/iv/2002.

Remarks: The regular spire profile and slightly convex form of *C. tupi* distinguish it from the almost flat whorls of *C. tigrina*, from the convexity in the posterior part of the whorls of *C. speculabunda*, from the more pupoid shell and thicker spiral cords of *C. spirocordata*, and from the more convex whorls of *C. noxia*.

Caelatura noxia n. sp. and *C. tupi* share the presence of secondary spiral cordlets between the main spiral cords, and distinct microtextures, visible only under high magnification. These two species can be separated by their overall shell profile, more triangular in *C. tupi* and more pupoid in *C. noxia*. Furthermore, the secondary spiral cordlets are always present in *C. noxia*, whereas they are only sporadically present in *C. tupi*.

Discussion

Although not all of the species are sympatric, they all occur in the Caribbean Province (Palacio, 1982) and there is little morphological variation among populations within species. An exception is *C. barcellosi* which shows umbilicate and non umbilicate populations (see Absalão 1995: 89) but there is no evidence for geographic variation or subspecies. Besides that, we

know so little about the real distibutional patterns of these minute molluscs that any attempt to establish biogeographical relationships would be too speculative.

The group formed by *C. albertoi*, *C. aulakion*, *C. rustica* and *C. gerhardtae* is characterized by its "smooth" appearance and it somewhat resembles some West African species described by Gofas (1995) as *Pseudodiala*. In a strict conchiological sense, *Pseudodiala* could be distinguished from *Caelatura* based on punctures both on the protoconchs and teleoconchs, although this character seems quite variable and future anatomical studies should resolve this matter. On other hand, *C. carinata*, *C. noxia*, *C. phrix* and *C. tupi* share among themselves a characteristic ornamentation pattern of the spiral cords with broad interspaces between them displaying unusual blade like laminae ridges. Although definition for the genus *Caelatura* comprises smooth, spirally and/or axially ornamented shells, it is possible that future anatomical researches will prove that the usual *Caelatura* concept may be polyphyletic.

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